

# *Introduction to Epidemiologic Methods*

Seattle Epidemiology and  
Biostatistics Summer Session  
June, 2004

## An epidemiologist is...

“An investigator who studies the occurrence of diseases or other health-related conditions or events in defined populations.”

J. Last, *A Dictionary of Epidemiology*, 4th ed.

## Uses of epidemiology—1

### **Assessing the burden of disease on a population**

- Which accounts for more trauma deaths each year in the U.S.—firearms or motor-vehicle crashes?
- Are community-acquired cases of pneumonia due to methicillin-resistant *S. aureus* increasing?

## Uses of epidemiology—2

### Identifying risk factors for disease

- Does living with a smoker increase your risk of lung cancer, even if you don't smoke yourself?
- What's the best kind of shoe for an older adult to wear in order to minimize risk of a fall?

## Uses of epidemiology—3

### Evaluating efforts at disease control

- Did prompt isolation of cases and contact tracing curtail the outbreak of SARS in Toronto?
- Have laws imposing a .08% legal limit for blood alcohol concentration among drivers been effective in reducing alcohol-related crash mortality?

## A definition of *epidemiologist* (revisited)

“An investigator who studies the occurrence of diseases or other health-related conditions or events in defined populations.”

J. Last, *A Dictionary of Epidemiology*, 4th ed.

## *Diseases*

### **Example of an epidemiologic case definition: *fall***

- Unintentional descent to the ground or other supporting surface, resulting in ground contact by a body part above the ankle
- Not preceded by loss of consciousness
- Not resulting from external force (e.g., being pushed or hit)
- Not involving equipment that supports body weight (e.g., sports gear or ladder)

### **Clinical diagnoses among fallers**

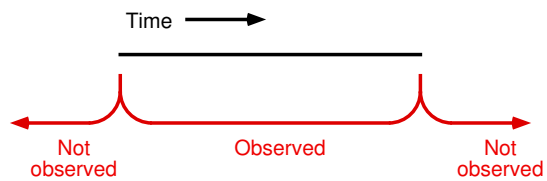
- Proximal femoral fracture
- Colle's fracture of the distal radius
- Concussion
- Laceration
- Contusion

### Epidemiologic case definition vs. clinical diagnosis

Feature	Epidemiologic case definition	Clinical diagnosis
Seeks to identify and combine cases that . .	have shared <i>causes</i>	respond to similar <i>treatments</i> , have similar <i>prognosis</i>
Requires data that . .	are available or obtainable on a population scale	can guide clinical management, but may be costly or invasive to obtain

### Disease Models

### Time Line for a Person



### Disease events

- *Instantaneous occurrence* at a point in time, with negligible duration
- Examples: fall, sudden infant death syndrome, spontaneous abortion, aneurysm rupture



- Closely tied to concept of *incidence* (to be covered soon)

### Disease states

- Characterize an individual *over a period of time*
- Examples: depression, gallbladder disease, upper respiratory infection



- Closely tied to concept of *prevalence* (to be covered soon)
- *Onset* of a disease state can be treated as an event in its own right

### Recurrent and non-recurrent disease

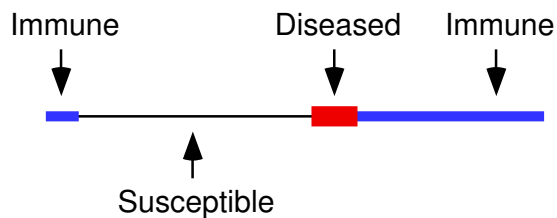
	Recurrent	Non-recurrent
Event:	Fall	Sudden infant death syndrome
State:	Urinary tract infection	Alzheimer's disease

## Susceptibility

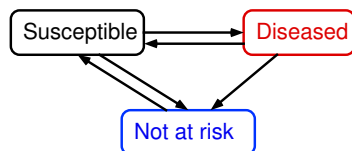
- For some diseases, some persons known a priori to be *non-susceptible* = *not at risk*
- Examples:
  - Men not at risk for uterine cancer
  - Women not at risk for prostate cancer
- For other diseases, a person's susceptibility may change over time—e.g., appendicitis



## Measles

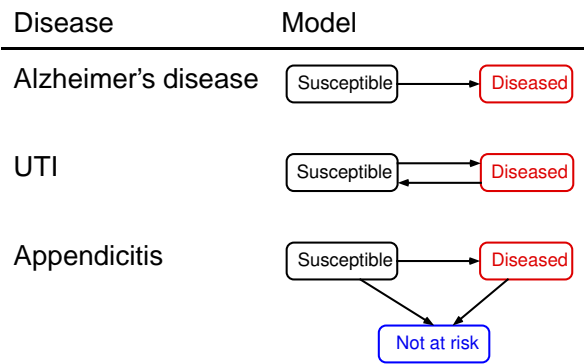


## Generic epidemiologic model of disease



- At any given time, each person is in one of the 3 boxes
- *Prevalence* concerns number or proportion of population members in the **Diseased** box
- Over time, people can move from box to box
- *Incidence* concerns number or proportion who move from the Susceptible to the **Diseased** box over time

### Sometimes a simpler model may suffice

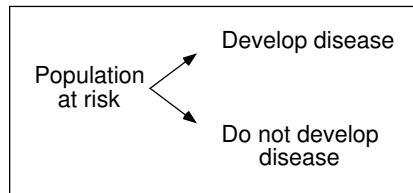


## *Populations*

### What is a *defined* population?

- The “base” or “denominator” for a set of cases
- Almost always defined by specifying certain shared:
  - Personal characteristics
    - Sociodemographic attributes
    - Ties to an organization—e.g., health plan, company, or school
  - Place of residence (or work, etc.)
  - Time or time period when under observation

### A *closed* population



- All members initially at risk
- Everyone monitored for new disease occurrence over the same fixed time period
- No gains or losses in membership during the study time period (except due to disease occurrence itself)

### Closed population examples

- Passengers on a certain airline flight
- Players in a football game during a certain play
- Attendees at a certain church picnic (e.g., in a short-term foodborne disease outbreak)
- Participants in a clinical trial with complete follow-up

### An *open* population



- Can gain or lose members over time—e.g., by:
  - Births and deaths
  - Changes in eligibility for membership (in- and out-migration)
  - Occurrence of new cases, recovery of old ones
- More common than closed populations in practice



### Open population examples

- Population of Washington state during 2004
- Players for the Seattle Mariners during 2004
- Enrollees in a certain HMO during 2004

### Have we identified the correct base population?

- Goal: ascertain all cases in a defined population at risk
- Cases and population correspond if both of the following tests are met:
  - If each of the cases had *not* had the disease, would he/she still be included in the proposed population at risk?
  - If each of the non-cases in that population *had* developed the disease, would he/she have been included in the set of cases?

**Introduction to Epidemiologic Methods — Summer, 2004**  
**Discussion Questions: Diseases and Populations**

1. A recent study sought to test the hypothesis that the risk of developing an upper respiratory infection (URI or “cold”) following an airline flight is greater if the airliner recirculates cabin air rather than using fresh air from outside the plane to ventilate the cabin. The investigators recruited 1,501 passengers who were about to fly from the San Francisco area to Denver. Each person was classified according to whether his or her aircraft used fresh or recirculated air. Tracking information was also collected so that each person could be contacted again after 5–7 days to determine whether a new URI had developed.

Which of the following would you consider to be suitable features of the case definition for such a study? Why?

- Self-report of a cold
  - Self-report of a cold, but with certain specific symptoms required to be present
  - Any of several specific combinations of self-reported cold symptoms
  - Visited a medical professional for symptoms that were diagnosed as a URI
  - Observed by a medical professional to have a reddened throat
  - Positive throat culture
  - Blood test positive for recent exposure to at least one common pathogen known to cause URIs
2. Epidemiologic study of a condition often begins by trying to identify all cases of the condition that occur in a defined population. For each of the following sets of cases, identify, if you can, the corresponding defined population at risk.
    - (a) All cases of hospital-acquired (nosocomial) infection among inpatients at University Hospital during 2003.
    - (b) All cases of influenza who were treated by one of several hundred volunteer “sentinel physicians” throughout the U.S. during December, 2002 through March, 2003.
    - (c) All cases of sudden cardiac death occurring in King County, Washington, during 2000.